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Bacteraemia Following Different Orthodontic Treatment Procedures

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Abstract

The purpose of this research was to estimate the percentage and nature of bacteraemia following four orthodontic treatment procedures which were: an upper alginate impression, separator placement, band fitting or placement, and arch wire adjustment on a fixed appliance. The study group consisted of 40 patients (25 females and 15 males) ranging from 17-25 years of age attending Orthodontic Department in the College of Dentistry/Baghdad University, and out patients department from private clinic. The 40 patients were divided into four groups (10 patients each). A cannula was inserted into either the left or right antecubital fossa using an aseptic technique. A 5ml of blood was taken immediately before orthodontic treatment procedure and a second 5ml sample was taken 1-2 minutes after the procedure.

The blood samples showed a percentage of bacteraemia of 50%, 40%, 30%, and 20% in cases of post-band placement, post-separator placement, post-arch wire adjustment, and post-alginate impression procedures respectively.

This investigation demonstrated that the placement of separator and fitting of band procedures could cause a significant bacteraemia, thus these procedures for patients at-risk of bacterial endocarditis should be placed in consideration, and the orthodontist should be advised to consult the patient's medical specialist for controlling and prescribing the necessarily antibiotic coverage.

Keywords: Bacteraemia, Orthodontic treatment procedures.

Introduction

Occurrence of bacteraemia has been investigated in a variety of dento-manipulative procedures such as extraction, periodontal operations, endodontic procedures, dental prophylactic, and tooth brushing ^(1,2,3). Transient bacteraemia that occurs after these procedures reportedly lasts from about 10 to 30 minutes and is clinically un important for healthy individuals ^(4,5). On the other hand, transient bacteraemia can be a risk factor for patients with the following conditions ^(6,7): prosthetic cardiac valves; previous bacterial endocarditis; surgically

constructed systemic-pulmonary shunts; most congenital cardiac malformations; rheumatic and other acquired valvular dysfunction; hypertrophic cardiomyopathy; mitral valve prolapse with valvular regurgitation; synthetic vascular grafts; and prosthetic joint .

Prophylactic antibiotic intake is recommended in association with dental procedures that are likely to cause gingival bleeding in risk factor patients to prevent endocarditis ^(8,9). Although bleeding is a poor predictor of bacteraemia, however, it is still not clear whether antibiotic cover is

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needed during different orthodontic treatment procedures. Moreover the majority of orthodontic patients are not able to perform effective bacterial plaque control easily and therefore develop mild to moderate gingivitis in association with fixed appliance treatment^(10,11).

The 2007 Heart Association Guidelines state that endocarditis prophylaxis is recommended for initial placement of orthodontic bands but not brackets⁽¹²⁾. However earlier surveys of American and British orthodontists have shown that, while many orthodontists prescribed antibiotics before banding for at risk patients, a significant portion of orthodontists did not think antibiotic therapy was necessary^(13,14).

This variation in the handling of at risk patients may be due to lack of data confirming the need for antibiotic prophylaxis before orthodontic procedures. More studies are needed to clarify this clinical issue. The aim of the current study was to investigate the percentage of bacteraemia following four orthodontic procedures. These were an upper alginate impression, placement of separator, fitting or placement of band, and arch wire adjustment on a fixed appliance among a representative sample of patients.

Materials and Methods

The study group consisted of 40 patients (25 females and 15 males) ranging from 17-25 years of age, with an average of 18.5 years attending Orthodontic Department at College of Dentistry/Baghdad University, and out patients department from private clinic. In accordance with the terms of the ethical approval for this investigation, the procedure was explained in details to each subject and written consent obtained.

All patients were given standard oral hygiene instructions, including the use of tooth brush and called for an appointment one week later. On this appointment, plaque and gingival indices were carried out^(11,15), and only those subjects with plaque index equal or below two, and gingival index equal or below one were included in this study group⁽¹⁶⁾.

Patient exclusion criteria⁽¹⁶⁾:

- Congenital heart disease.
- History of rheumatic fever.
- Aortic stenosis, mitral stenosis, or both.
- Prosthetic heart valves.
- History of subacute bacterial endocarditis.
- Hypertrophic cardiomyopathy.
- Surgically constructed systemic-pulmonary shunts.
- Vascular or joint prostheses.
- Immunosuppression.
- Diabetes.
- Bleeding disorder.
- Pregnancy.
- Antibiotic usage within the past three months.
- Regular usage of antiseptic mouthwash.
- Restoration adjacent to gingival margin on a selected molar.

The 40 patients were divided into four groups (10 patients each); these four groups represented the four orthodontic treatment procedures.

Orthodontic treatment procedures: Include

1. An upper alginate impression: was taken for the upper dental arch using stainless steel rimlock tray and alginate impression material (Hydrogum, Italy).
2. Placement of elastic separator: used round cross section elastic separators (Dentalastics, Dentaurum; Germany), the site of placement was done

- mesial and distal to the upper first molars using separating pliers (Dentaurum; Germany).
3. Placement of band: after primary band size selection on study model that was taken from the upper alginate impression, band seating was done by band seating instrument (Dentaurum; Germany) after that the upper first molar was dried and pre-adjusted band was cemented with chemical glass-ionomere cement (Promedica; Germany) .
 4. Arch wire adjustment: it was done on a fixed appliance during the first stage of comprehensive orthodontic treatment (alignment and leveling), using Roth system brackets with slot size 0.018 of an inch (Elite, Optimini, Ortho-organizer; USA) bonded to the teeth by orthodontic chemical cure bonding system (Alpha-dent; USA) following the standard technique for the bonding procedure, and 0.014 of an inch nickel titanium wire (Ortho-organizer; USA) was ligated by elastomeric ligatures (Ortho-organizer; USA).

Blood sample collection:

A pre-orthodontic procedure blood sample was taken from each of the subjects just immediately before orthodontic procedure to act as a control and to ensure that any post-procedure bacteraemia discovered could be attributed to the orthodontic procedure. For all the subjects, the skin on either the left or right ante-cubital fossa was prepared with 10% povidone iodine solution (ERFAR Pharmaceutical Laboratories, Greece). A blood sample of 5ml was obtained from an antecubital vein with a strict aseptic technique using a 20 g sterile plastic cannula (HECOS, SHANGHAI MEDICINES & HEALTH PRODUCTS IMP. & EXP. CORP; China) and a sterile syringe

(Pingdingshan Shengguang Medical Instrument Co.,Ltd; China), all the pre-orthodontic procedures blood samples were taken immediately before the procedures while the post-procedures blood samples were taken one to two minutes after the procedures. A total blood samples of 10 milliliters were taken from each patient (5 milliliters for each pre and post-orthodontic procedures) and aseptically inoculated into Brain-Heart-Infusion culture bottles (Himedia Laboratories Pvt. Ltd., Mumbai; India), then these were incubated at 37 ° C for 10 days and subcultured into both blood agar and blood agar supplemented with 0.0005% hemin and 0.00005% menadione (Himedia Laboratories Pvt.Ltd., Mumbai; India), then these were inocubated under aerobic conditions. Bacterial colonies were identified by colony morphology, gram staining procedure, standard microbiologic biochemical testing technique and API 20 strips. All the laboratory procedures were performed by the aid of Baghdad Teaching Laboratories and AL-Saffwa Laboratory in Baghdad city.

Outcome measures: These were

1. Frequency of occurrence of bacteraemia recorded as the number of positive blood cultures, and also expressed as a percentage.
2. Identity of bacteria.

Identification of bacteria: All the bacteria were identified to genus level ⁽¹⁷⁾ except for the oral streptococci, which were identified to species level ⁽¹⁸⁾.

Statistical analysis: Data were collected and subjected to computerized statistical analysis using Statistical Package for Social Science computer software (SPSS, version 14) in which the descriptive statistics included frequency distribution and percentage of variables, while the inferential statistics included the use of

Wilcoxon test for categorical data to do a comparison between pre and post-orthodontic treatment procedures. Probability levels less than 5% were regarded as statistically significant.

Results

Frequency of occurrence of bacteraemia:

No bacteraemia of oral origin was detected in blood samples of pre-alginate impression and pre-placement of separator procedures, while it was detected in one of ten subjects (10%) in cases of pre-placement of band and pre-arch wire adjustment.

The bacteraemia of oral origin was obviously detected in post – orthodontic procedures, with highest percentage (50%) five of ten blood samples in case of post-placement of band, with high percentage of bacteraemia (40%) four of ten blood samples in case of post-placement of separator, with intermediate percentage (30%) three of ten blood samples in case of post-arch wire adjustment, and with low percentage (20%) two of ten blood samples in case of post-alginate impression procedure, as demonstrated in Table 1.

Comparison between pre- and post-orthodontic procedures:

Wilcoxon test was used to match between the pairs of pre and post-orthodontic procedures; it showed no significant difference in the number of positive blood cultures between pre and post - procedures in cases of alginate impression and arch wire adjustment at $P > 0.05$, while there were significant differences between pre- and post-procedures blood samples with respect to percentage of bacteraemia in cases of placement of separator and band placement at $P < 0.05$ as shown in Table 2.

Identity of bacteria isolated:

The bacteria isolated from pre-orthodontic procedures blood samples included *coagulase negative Staphylococci*, *Streptococcus species* (*S. oralis* , and *S. mitis*) , and miscellaneous including *Corynebacterium species* and *Micrococcus species*. While the bacteria isolated from the post-procedures blood samples included *coagulase negative Staphylococci* accounted 60% of the post-procedures bacterial isolates, *Streptococcus species* 35% (*S. sanguis*, *S. salivarius*, *S. gordonii*, *S. vestibularis*), and 5% miscellaneous including *Micrococcus species*, *Aerococcus species*, and *Stomatococcus mucilaginosus*.

Discussion

Since the presence of prosthesis or orthodontic appliances tend to retain bacterial plaque and food debris. It is clearly important to determine which procedures in the provision of orthodontic care are likely to cause a bacteraemia, so that an informed decision can be made regarding antibiotic prophylaxis for individuals at risk of bacterial endocarditis. Bacteraemia are common daily events even in healthy individuals⁽¹⁹⁾.

Spontaneous bacteraemia of oral origin can arise even from chewing, dental examination, or tooth brushing^(12,20,21,22), there is limited data on orthodontic treatment and bacteraemia. The important question is whether orthodontic procedure increases the prevalence of bacteraemia beyond that normally found. A study reported the prevalence of bacteraemia following tooth brushing in patients wearing fixed appliances is 25 %⁽³⁾, and the prevalence could reach 60-70 % following extractions, scaling or gingival surgery^(1,19,23).

In the present study the bacteraemia of oral origin that was detected in blood samples of post-alginate impression procedure was 20%, this may be due to the impression material could introduce into the gingivae and gingival crevices with subsequent bleeding during taking the impression leading to introduction of bacteria into the blood stream and subsequent bacteraemia, this percentage considered to be a low value if compared with the other post-orthodontic procedures of the present study, as shown in Table 1. This percentage disagreed with the percentage of 31% that was observed in other research ⁽²⁴⁾, this disagreement could be due to the difference in the technique used in the blood culturing, in addition the sample size could play another role.

The bacteraemia that was detected in blood samples of post-placement of separator was 40%, this percentage considered to be high value if compared with the remaining post-orthodontic procedures of the present study as shown in Table 1. This may be due to that elastic separator causes trauma and bleeding in the interdental area during placement of the separator and could further introduce bacterial plaque and food debris to the gingival crevices in the interdental area, in addition the relative rough surface of the elastic material of the separator could act as a good focus that harboring bacteria if compared with smooth surface of the wire separator that was used in other study ⁽²⁴⁾, therefore the percentage of post-placement of elastic separator in the present study was 40%, which disagreed with the previous study where it was 36% ⁽²⁴⁾.

The bacteraemia that was detected in blood samples of post-placement of band was 50%, this percentage considered to be highest value if

compared with the remaining post-orthodontic procedures of the present study as shown in Table 1, this may be due that the space created by the separator facilitates the band placement. Despite the expected increase in the plaque and gingival inflammation that may occur in the removal area of the separator, the band may force further accumulated bacteria into the gingival margin and subsequently a highest percentage of bacteraemia can be recorded. Other studies had reported bacteraemia percentages of 7.5%, 10%, and 44% following band placement ^(24,25,26), this variation in the percentage of bacteraemia may be due to timing difference in the blood samples collected from the post-orthodontic procedures. For optimal detection of bacteraemia, it has been recommended that the blood should be collected no later than two minutes after trauma to the gingival margin or vigorous dento-
gingival manipulation ^(24,27,28), therefore in the present study the post-orthodontic procedures blood samples collected and completed in less than two minutes to ensure that the most traumatic procedure and the most likely to precipitate a bacteraemia.

The bacteraemia that was detected in blood samples of post-arch wire adjustment was 30%, this percentage considered to be intermediate value if compared with the post orthodontic procedures of the present study, as shown in Table 1, the fact behind that is the arch wire which causes trauma to the buccal mucosa, gingival or even the alveolar mucosa, and then it introduces bacteria and subsequently bacteraemia may be occurred specially in poor oral hygiene subjects. The intermediate prevalence of post-arch wire adjustment in the present study disagreed with other research ⁽²⁴⁾, this could be due the difference in the

orthodontic arch wire adjustment techniques.

There were no significant differences in the number of positive blood cultures between pre and post-orthodontic procedures in cases of alginate impression and arch wire adjustment, as shown in Table 2, and this was in agreement with other research⁽²⁴⁾, while there were significant differences in the number of positive blood cultures between pre- and post-procedures in cases of separator placement and fitting of band, this significance could play an important clinical role in the decision of prescribing antibiotics to prevent bacteraemia. Moreover, there is not enough scientific data to confirm the need for antibiotic prophylaxis during certain orthodontic procedures, as the use of antibiotics carries its own risks, the incidence and prevalence of bacteraemia should be elucidated by further research, and prophylactic antibiotics cover should be performed on a sound basis. In order to control the risk of the bacteraemia, it has been recommended that any dental procedure that would induce bleeding should be preceded by antibiotic prophylaxis 30 minutes to one hour before the procedure⁽²⁶⁾. Other studies have shown that gingival bleeding does not necessary cause bacteraemia in every case, and that bacteraemia can develop in the absence of bleeding^(25,26).

The bacterial species that were isolated from the blood cultures including *coagulase negative Staphylococci* and *Streptococcus species*, both have been isolated from blood cultures following dental operative procedures^(20,27,28). They also implicated in the etiology of bacterial endocarditis⁽²⁹⁻³⁶⁾, especially the oral streptococci are the predominant species implicated in the bacterial endocarditis and percentages

accounted between 40%⁽³⁷⁾ and 60%⁽³⁸⁾ of post-procedure isolates, which differ from the present study where it was 35%. No explanation for this difference in the post-procedures streptococcal account between these studies other than difference in materials and methods.

Conclusion

Management of at-risk patient is a very important matter, and the orthodontist should evaluate the level of risk patient. The oblivious lack of antibiotic coverage for at-risk patient during certain orthodontic procedures, especially placement of band and separator because of their significance in this study could involve legal exposure for the orthodontist, and the orthodontist should be advised to consult the patient's cardiologist and thus share the responsibility.

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Table 1: Number and percentage of positive blood cultures (bacteraemia)

Group		N	Wilcoxon test	P-value	Significance
Alginate impression	Pre-procedure	10	95.00	0.146	NS
	Post-procedure	10			
Placement of separator	Pre-procedure	10	85.00	0.029	S
	Post-procedure	10			
Fit/Placement of band	Pre-procedure	10	85.00	0.047	S
	Post-procedure	10			
Arch wire adjustment	Pre-procedure	10	95.00	0.276	NS
	Post-procedure	10			

N= number of subjects

Table 2 : Comparison between pre- and post- procedures using Wilcoxon matched pairs test.

Group	N	Pre-procedure	Post-procedure
Alginate impression	10	0	2 (20%)
Placement of separator	10	0	4 (40%)
Fit/Placement of band	10	1 (10%)	5 (50%)
Arch wire adjustment	10	1 (10%)	3 (30%)

S=Significant (P<0.05)

NS =Not significant (P>0.05)